Final Technical Memorandum

Sewer Project Identification Process

Wastewater Infrastructure Partnership

LAKE TAHOE BASIN, CALIFORNIA & NEVADA

Lake Tahoe
Wastewater
Infrastructure
Partnership

US Army Corps of Engineers ®
Sacramento District

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Acronyms and Abbreviations

CCTV	Closed Circuit Television
CIP	Capital Improvement Program
CIPP	Cured-in-place pipe
CMOM	Capacity Assurance, Management, Operations, and Maintenance
Corps	US Army Corps of Engineers
DCSID	Douglas County Sewer Improvement District No. 1
Districts	Lake Tahoe Basin Wastewater Sewer Districts
EIP	Environmental Improvement Program
IVGID	Incline Village General Improvement District
KGID	Kingsbury General Improvement District
LPR	Lining point repair
MPR	Major point repair
NASSCO	National Association of Sewer Service Companies
NDEP	Nevada Department of Environmental Protection
NTPUD	North Lake Tahoe Public Utility District
PACP	Pipeline Assessment Certification Program
Partnership	Lake Tahoe Basin Wastewater Infrastructure Partnership
PR	Point repair
QA/QC	Quality assurance/quality control
RHGID	Round Hill General Improvement District
SSOs	Sanitary Sewer Overflows
STPUD	South Tahoe Public Utility District
TCPUD	Tahoe City Public Utility District

TDGID	Tahoe-Douglas General Improvement District
TRPA	Tahoe Regional Planning Agency
USEPA	US Environmental Protection Agency
WDR	Waste Discharge Requirement

FINAL TECHNICAL MEMORANDUM
SEWER PROJECT IDENTIFICATION PROCESS
WASTEWATER INFRASTRUCTURE PARTNERSHIP
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1.0 Purpose

The purpose of this technical memorandum is to document the sewer repair, rehabilitation, and replacement project identification process developed for use by the Lake Tahoe Basin Wastewater Infrastructure Partnership (Partnership). The project identification process will standardize identification of collection system gravity sewer repair, rehabilitation, and replacement projects using a condition assessment decision process and corresponding flow diagram. This condition assessment decision process considers the type, severity, and number of defects in each line segment to objectively recommend which sewer lines should be scheduled for maintenance, point repair, rehabilitation, or replacement. The Partnership will use the decision process to analyze compiled closed circuit television (CCTV) inspection data to develop a list of gravity sewer projects for inclusion into the Lake Tahoe Basin Project Database.

Eight sewer districts (Districts) currently operate within the Lake Tahoe Basin.

1. North Tahoe Public Utility District (NTPUD)
2. South Tahoe Public Utility District (STPUD)
3. Incline Village General Improvement District (IVGID)
4. Douglas County Sewer Improvement District No.1 (DCSID)
5. Tahoe-Douglas General Improvement District (TDGID)
6. Tahoe City Public Utility District (TCPUD)
7. Kingsbury General Improvement District (KGID)
8. Round Hill General Improvement District (RHGID)

The Districts, with the US Army Corps of Engineers (Corps), form the Partnership.

2.0 Background

A basin-wide Environmental Improvement Program (EIP) is being implemented in the Lake Tahoe area to address identified environmental thresholds. A recent study of existing wastewater systems in the Basin concluded that a capital replacement program would be required to efficiently upgrade infrastructure to minimize environmental impacts from sewer failure.

Currently, Tahoe Regional Planning Agency (TRPA) ordinances require that Districts implement plans for detecting and correcting sewage exfiltration problems in their collection and transport facilities. New regulations require that these Districts also develop capacity assurance, management, operations, and maintenance (CMOM) programs. Intended to reduce sanitary sewer overflows (SSOs), CMOM programs include detailed system assessments, ongoing monitoring, reporting, recordkeeping and more.

While a national CMOM regulation originally proposed by the US Environmental Protection Agency (USEPA) appears to be on hold indefinitely, California's State Water Resources Control Board has issued a Waste Discharge Requirement (WDR), similar to the USEPA's proposed CMOM regulation, for wastewater collection systems. A similar regulation has not been passed in Nevada, but the Nevada Department of Environmental Protection (NDEP) is beginning to look more closely at SSOs and has recently increased enforcement actions related to wastewater collection systems.

Districts will need to perform CCTV inspection of their collection systems to detect and correct exfiltration problems and pipe defects that may lead to increased risk of sewer overflows. The standardized condition assessment decision process and flow diagram were developed to assist Districts with consistently and objectively analyzing CCTV inspection data in response to TRPA ordinances and new regulations. A database algorithm will be used to analyze CCTV inspection data to generate preliminary condition-based recommendation that can be used by Districts to identify gravity sewer projects.

3.0 Project Identification Process

The project identification process can be roughly divided into the following five major steps. A detailed discussion of each step follows this overview.

- **Step 1 – Perform CCTV Inspections and Collect Sewer Inspection Data**: Sewer inspection data is collected using standard CCTV inspection and defect codes. Data is delivered to the Districts using an agreed upon standard data format. Using the CCTV inspection data, District inspection crews and inspection contractors identify pipe segments that contain critical defects as defined in Attachment 1 – Defect Code Categorization. A QA/QC review should be expedited on pipe segments identified as having critical defects.
- **Step 2 – Inspection Data Quality Assurance/Quality Control (QA/QC) and Data Management**: CCTV inspection data is received by the Districts and a QA/QC review is performed to ensure accuracy. Data is put into a central repository for analysis. Pipe segments verified as having critical defects should be submitted to District engineers for accelerated condition assessment and repair, rehabilitation, and replacement decision-making.

- **Step 3 –Analyze Data and Generate Preliminary Condition-Based Recommendation**: CCTV inspection data is analyzed using a database algorithm (following application of the standard condition assessment decision process) to generate a preliminary condition-based recommendation for each individual pipe segment. These preliminary condition-based recommendations account for structural and maintenance defects only. Other factors that may influence the final decision for a specific pipe segment are analyzed in Step 5.
- **Step 4 – Review Preliminary Condition-Based Recommendation and Generate Final Condition-Based Recommendation**: Preliminary condition-based recommendations are reviewed by individual District's using their District-specific protocols. Those preliminary recommendations approved by the Districts are added to a list of final condition-based recommendations.
- **Step 5 – Analyze Final Condition-Based Recommendations and Group Selected Sewer Pipes into Biddable Projects**: To make a final decision for a specific pipe segment, final condition-based recommendations are analyzed against other factors, which may include:
  - Hydraulic analysis results
  - Other infrastructure projects requiring coordination
  - Constructability considerations

  After analysis of final condition-based recommendations, approved sewer pipe segments are grouped into biddable projects that can be entered into the Partnership database.

This technical memorandum focuses on the condition assessment decision flow diagram and the generation of preliminary condition-based recommendations by individual pipe segments (Step 3 of the project identification process). Step 4 and Step 5 of the project identification process consist of reviews and evaluations using established District-specific protocols.

3.1 CCTV INSPECTION AND DATA COLLECTION

The condition assessment decision process assumes that Districts will use the CCTV Inspection and Defect Coding Standards developed for the Partnership as documented in the *CCTV Sewer Inspection Program Standards – Final Technical Memorandum*, February 2007. Within each District, staff responsible for the repair, rehabilitation, and replacement decision process should give instructions to District inspection crews and inspection contractors on how to identify pipe segments that may potentially have critical defects based on CCTV inspection data and as defined in Attachment A – Defect Code Categorization.

3.2 INSPECTION DATA QA/QC AND DATA MANAGEMENT

Inspection QA/QC

An expedited QA/QC review should be performed on the CCTV inspection data for pipe segments identified as potentially having critical defects. It is assumed that the QA/QC review will be conducted by consultant or District staff trained to use National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) defect code standards. Pipe segments verified as having critical defects should proceed through the condition assessment decision process.

Inspection QA/QC review of pipe segments that do not contain critical or major defects during the initial inspection can be performed by resources knowledgeable in the use NASSCO PACP defect codes under the supervision of a resource trained in the use of NASSCO PACP defect codes.

Data Management

It is assumed that all CCTV inspection data will be stored in a central repository using standard file formats. A centralized repository of information gives each District access to data needed to generate preliminary condition-based recommendations for pipe segments identified as having a critical defect within its jurisdictional boundary.

3.3 ANALYZE DATA AND GENERATE PRELIMINARY CONDITION-BASED RECOMMENDATION

The data analysis and preliminary condition-based recommendation generation processes were initially developed as a standardized and objective means of assessing the current condition of a pipe segment to determine the appropriate level of immediate maintenance required (e.g., line, maintain, point repair, renew or replace). Once the overall condition decision process was developed, it was determined that a database algorithm could be used to analyze data to generate preliminary condition-based recommendations. As part of the sewer project identification process, a database algorithm was developed for the Districts use. Database users notes are included in Attachment B. Experience has shown that greater than 85 percent of the preliminary recommendations generated using this process are accepted as final recommendations. Experience also indicates that attempts to improve accuracy resulted in an overly complicated and less precise process.

Preliminary Condition-Based Recommendation

The condition assessment decision process is used to analyze CCTV inspection data and pipe attribute data to generate one of the five decision recommendations (line, maintain, point repair,

renew, or replace) for a specific pipe segment. Definitions for the recommendation types are provided in Table 1.

Table 1. Condition Assessment Decision Process Recommendations

Recommendation	Definition
Line	A decision to perform internal lining of a pipe using a trenchless rehabilitation method such as cured-in-place pipe (CIPP), pipe bursting, etc.
Maintain	A decision to continue to maintain the pipe in the current condition as part of the ongoing maintenance program
Point Repair	A decision to perform a localized repair
Renew	A decision requiring further evaluation to choose between lining and replacement
Replace	A decision to 'remove and replace' or 'abandon and replace' a pipe

Defect Codes Categorization

CCTV defect codes were categorized into an appropriate defect code categories (e.g., bend/sag, critical, lining point repair, major, major point repair, or point repair). Definitions of defect code categories are provided in Table 2.

Table 2. Condition Assessment Decision Flow Diagram Defect Code Categories

Defect Code Category	Definition
Bend/Sag	A defect that indicates that the pipe contains a bend or a sag that will need to be evaluated prior to recommending lining versus replacement of the pipe
Corrosion	A defect that indicates the pipe has experienced severe corrosion
Critical	A defect that requires immediate review and potential immediate action through either an emergency or expedited project
Lining Point Repair (LPR)	A defect that can be corrected by a localized repair and that is necessary prior to lining a pipe
Major	A defect that is considered to significantly increase the risk of a sewer overflow
Major Point Repair (MPR)	A defect that is considered to significantly increase the risk of a sewer overflow, but can be corrected by a localized repair
Point Repair (PR)	A defect that can be corrected by a localized repair

A preliminary table of categorized defect codes was presented to the Partnership at a November 29, 2006 meeting. A representative of the Partnership (Joe Pomroy, IVGID) worked with the Corps contractor to review and modify the categories and categorization to match Partnership-specific needs. Attachment A contains a table with the final categorization of defects.

Decision Process

A flow diagram was created to graphically represent condition assessment decision process as a decision flow diagram (Figure 1). The condition assessment decision process flow diagram depicts how pipe segment data is systematically evaluated using decision points to derive an

objective decision outcome. The input (pipe segment data), eight decision points, and six potential decision outcomes are described in Table 3.

Figure 1. Condition Assessment Decision Flow Diagram

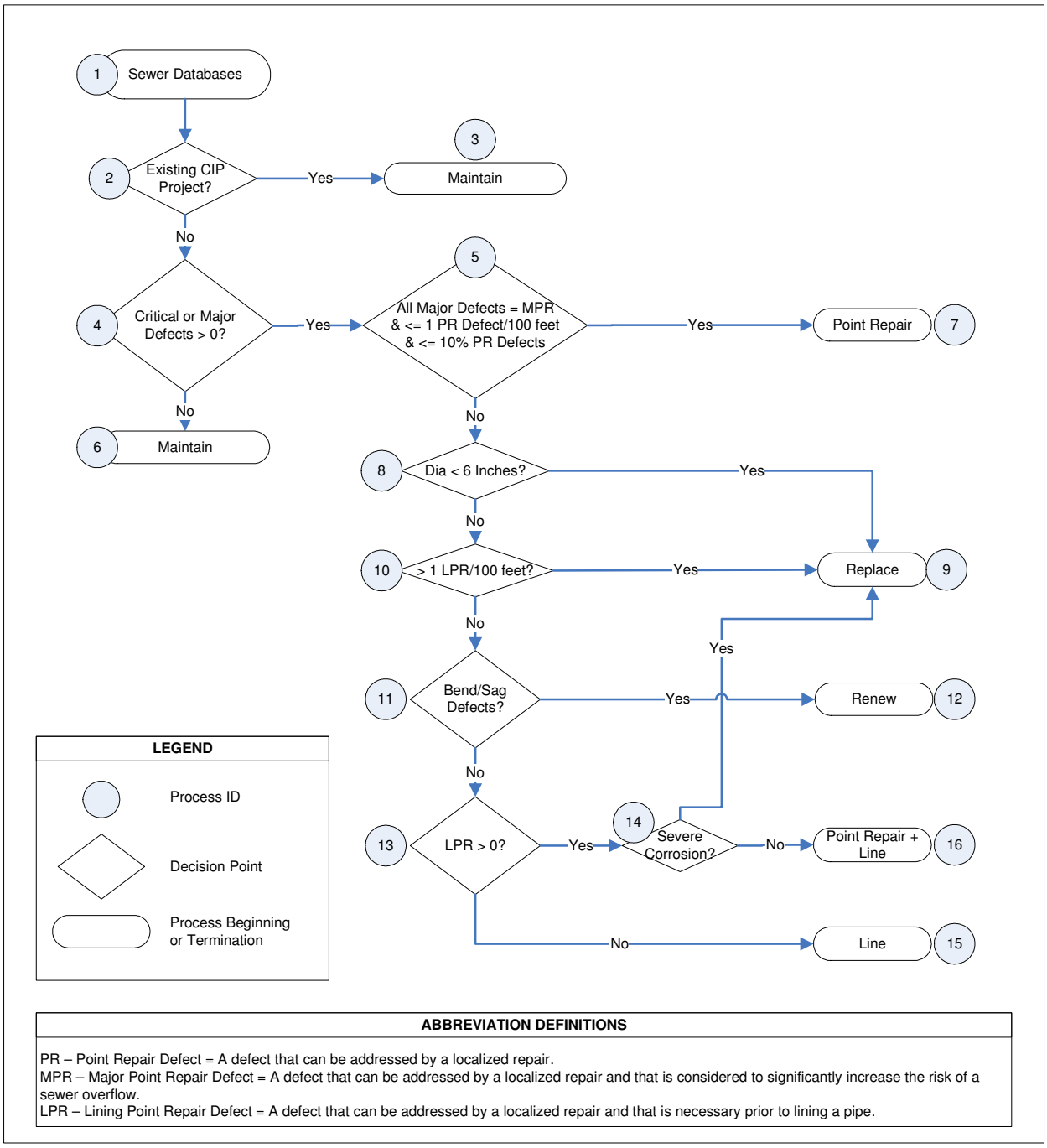

Table 3. Condition Assessment Decision Flow Diagram Process Explanations

Process ID	Type	Description	Explanation
1	Input	Sewer Databases	This refers to the data sets, including CCTV defects, defect code categorization, and pipe attribute data, used by the database algorithm.
2	Decision	Existing CIP Project?	This asks whether this pipe has an associated Capital Improvement Program (CIP) project that will address its existing defects. If yes, then a "Maintain" outcome results. If no, then the pipe will continue through the process.
3	Outcome	Maintain	This is a decision to continue the ongoing maintenance of the pipe segment because, in its current condition, it does not warrant immediate additional action.
4	Decision	Critical or Major Defects > 0?	This asks whether the pipe segment has a critical or major defect. If yes, then the pipe will continue through the decision process. If no, then a "Maintain" outcome results.
5	Decision	All Major Defects = MPR & <= 1 PR Defect/100 feet & <= 10% PR Defects	This determines if a point repair is feasible. This is determined via three criteria. 1) All major defects must be able to be addressed using a point repair solution (Major Defects = MPR). 2) There can be less than or equal to 1 PR per 100 feet of pipe. Experience and analysis show that more than 1 PR per 100 feet indicates a high risk pipe that should be lined or replaced. 3) No more than 10 percent of the pipe should require PR. Similar to the above statement, experience and analysis has shown that anything more and PR is not be a cost-effective solution.
6	Outcome	Maintain	This is a decision to continue the ongoing maintenance of the pipe segment because, in its current condition, it does not warrant immediate additional action.
7	Outcome	Point Repair	This is a decision to perform one or more localized repairs on the pipe segment to address defects.
8	Decision	Dia < 6 inches?	This asks whether the pipe is less than 6 inches in diameter. Going through the process, the pipe in question has already been shown to have major defects that cannot be addressed by PR. If yes, the pipe i is less than 6 inches in diameter, the decision will be to "Replace" the pipe. If the answer is no, then this pipe segment information will continue through the process.
9	Outcome	Replace	This is a decision to remove and replace the pipe because it failed one of the conditions necessary for the pipe to be point repaired or lined.
10	Decision	> 1 LPR/100 feet?	This asks whether there is more than 1 LPR per 100 feet. More than 1 LPR per 100 feet would cost the equivalent of replacement. If this is the case, then the decision will be to "Replace" the pipe instead. If this is not the case, the pipe will continue through the process.
11	Decision	Bend/Sag Defects?	This asks whether bend/sag defects exist. If bend/sag defects exist, then further evaluation will need to be performed to determine if the defect needs to be repaired, can be repaired, and if a lining project is feasible. If yes, then the decision will be "Renew". If no, then the pipe will continue through the process.

Process ID	Type	Description	Explanation
12	Outcome	Renew	This outcome indicates that District staff must evaluate whether to line or replace the pipe segment based on a review of the pipe defects.
13	Decision	LPR > 0?	This asks whether the pipe has any PRs that need to be addressed prior to lining. If yes, then the result will be to continue through the process. If no, the result will be a decision to line.
14	Decision	Severe Corrosion?	This asks whether severe corrosion exists in the pipe. Pipes with severe corrosion can be difficult to PR. If yes, then the result will be to "Replace" the pipe. If no, then the result will be to "Point Repair + Line" the pipe.
15	Outcome	Line	This is a decision to line the pipe.
16	Outcome	Point Repair + Line	This is a decision to perform necessary PRs and line the pipe.

3.4 GENERATION OF FINAL CONDITION-BASED RECOMMENDATION

A QA/QC review is performed on generated preliminary condition-based recommendations to validate the results. Typically this consists of reviewing the CCTV-related information, (including video and inspection results), preliminary condition-based recommendation, and associated CCTV defect analysis results. This process can be performed manually or supported by a variety of automated information management tools. The preliminary to final condition-based recommendation QA/QC process is an important step in the decision-making process as analysis of deviations between the preliminary and the final recommendations may result in modifications and refinements to the condition assessment decision flow diagram and database algorithm.

Pipe segment preliminary condition-based recommendations validated through the QA/QC review become final condition-based recommendations.

3.5 ANALYZE RECOMMENDATIONS AND GROUP PIPE SEGMENTS INTO BIDDABLE PROJECTS

Pipe segments with final condition-based recommendations statuses are analyzed against other factors, which may include:

- Hydraulic analysis results, including:
  - an analysis of the existing pipe diameter and whether it meets the existing and future capacity needs of the system

  - an analysis of the impacts of lining a pipe and whether the lining will impact the ability of the pipe to meet existing or future capacity needs
- Mapping the preliminary condition-based recommendations for a constructability analysis
- Cost analyses of different alternatives
- Other short or long-term infrastructure projects that may need to be coordinated with the pipe segment action

After analysis of final condition-based recommendations, approved pipe segments are appropriately grouped into bid packages based on construction methodologies, geographic proximity, coordination with other District projects, and available funding. These biddable projects are then entered into the Partnership project database.

Attachment A: Defect Code Categorization
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